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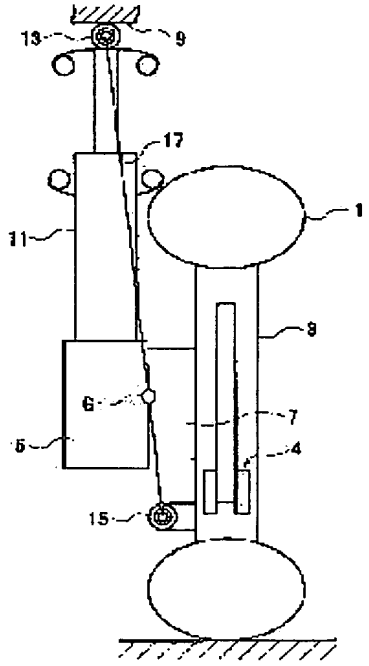
(54) MOTOR MOUNTING STRUCTURE OF WHEEL-IN MOTOR VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce inertia weight around a virtual kingpin shaft, and prevent an increase in steering force without deteriorating fuel consumption.
SOLUTION: A wheel-in motor 5 is installed on an axle 3 for rotatably supporting a wheel 1 via speed reducer 7. A shock absorber 11 is arranged between the wheel-in motor 5 and a car body 9. The center of gravity G of a rotary part (such as the wheel 1, the axle 3 and the motor 5) for rotating at steering time is set on the virtual kingpin shaft 17 for connecting an upper mount 13 being a car body side installing part of the shock absorber 11 and a lower ball joint 15 being an axle side installing part of a suspension link for connecting the axle 3 and the car body under the wheel-in motor 5.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It has the motor which is attached in the axle which supports a wheel pivotable and drives said wheel, and is attached between said axles and car bodies. The car-body side attachment section of the shock absorber which can be expanded and contracted in the direction of an axis, The center of gravity of a rotating part rotated at the time of steering centering on the virtual king-pin shaft to which the axle side attachment section of the suspension link which connects between an axle and car bodies is connected with the lower part of said motor Motor loading structure of the wheel in motor vehicle characterized by having arranged on said virtual king-pin shaft.
[Claim 2] Motor loading structure of the wheel in motor vehicle according to claim 1 characterized by having arranged 3 component doubling ****** of a wheel, an axle, and a motor on a virtual king-pin shaft.
[Claim 3] Motor loading structure of the wheel in motor vehicle according to claim 1 characterized by having arranged the center of gravity of a motor on a virtual king-pin shaft.
[Claim 4] Motor loading structure of the wheel in motor vehicle according to claim 1 characterized by having arranged the reducer which slows down and transmits rotation of a motor between a motor and an axle, and having arranged 4 component doubling ****** of a wheel, an axle, a motor, and a reducer on a virtual king-pin shaft.
[Claim 5] Motor loading structure of the wheel in motor vehicle according to claim 1 characterized by having arranged the reducer which slows down and transmits rotation of a motor between a motor and an axle, and having arranged 2 component doubling ****** of a motor and a reducer on a virtual king-pin shaft.
[Claim 6] the drive gear which meshes with the output gear which a reducer consists of epicyclic gear devices equipped with Sun Geer and a planetary gear, and carries out coaxial rotation with the output shaft of this epicyclic gear device -- the lower part location of said output gear -- the center-of-rotation shaft of a wheel -- the same axle -- the motor loading structure of the wheel in motor vehicle according to claim 4 or 5 characterized by preparing pivotable.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the motor loading structure of the wheel in motor vehicle equipped with the motor which is attached in the axle which supports a wheel pivotable and drives a wheel.
[0002]
[Description of the Prior Art] Conventionally, as motor loading structure of a wheel in motor vehicle, there are some which were indicated by JP,5-116545,A, for example. This tends to make said scrub radius small and tends to reduce increase of the control force produced according to it being large, the distance, i.e., the scrub radius, of the intersection of a virtual king-pin shaft and a road surface, and the intersection of the center line of the tire cross direction, and a road surface.
[0003]
[Problem(s) to be Solved by the Invention] However, if it is in the motor loading structure of the above-mentioned conventional wheel in motor vehicle, to a virtual king-pin shaft, the inertia weight of the circumference of the tire, roadwheel, and virtual [axle brake components have offset greatly on the car outside further, and / the result] king-pin shaft at the time of steering may be large, and sense of incongruity (a control force is heavy) may be sensed for steering. Although there is an approach by the pump capacity increase of hydraulic power steering as a means solved in this, for example, an engine load becomes large and there is a problem that fuel consumption gets worse.
[0004] Then, this invention aims at making small inertia weight of the circumference of a virtual king-pin shaft, and preventing increase of a control force, without causing aggravation of fuel consumption.
[0005]
[Means for Solving the Problem] In order to attain said purpose, invention of claim 1 It has the motor which is attached in the axle which supports a wheel pivotable and drives said wheel, and is attached between said axles and car bodies. The car-body side attachment section of the shock absorber which can be expanded and contracted in the direction of an axis, It has considered as the configuration which has arranged the center of gravity of a rotating part rotated at the time of steering centering on the virtual king-pin shaft to which the axle side attachment section of the suspension link which connects between an axle and car bodies is connected with the lower part of said motor on said virtual king-pin shaft.
[0006] According to the motor loading structure of the wheel in motor vehicle of such a configuration, at the time of steering, the center of gravity rotates the rotating part which rotates a virtual king-pin shaft as a core in the condition of having been located on the virtual king-pin shaft.
[0007] Invention of claim 2 is considered as the configuration which has arranged 3 component doubling ****** of a wheel, an axle, and a motor on a virtual king-pin shaft in the configuration of invention of claim 1.
[0008] According to the above-mentioned configuration, at the time of steering, three components with which the wheel, axle, and motor which rotate a virtual king-pin shaft as a core were aligned rotate, where the 3 component doubling ****** is located on a virtual king-pin shaft.
[0009] Invention of claim 3 is considered as the configuration which has arranged the center of gravity of a motor on a virtual king-pin shaft in the configuration of invention of claim 1.
[0010] According to the above-mentioned configuration, at the time of steering, the motor which rotates a virtual king-pin shaft as a core rotates, where the center of gravity is located on a virtual king-pin shaft.
[0011] Invention of claim 4 is considered as the configuration which has arranged the reducer which slows down and transmits rotation of a motor between a motor and an axle, and has arranged 4 component doubling ****** of a wheel, an axle, a motor, and a reducer on a virtual king-pin shaft in the configuration

of invention of claim 1.
[0012] According to the above-mentioned configuration, at the time of steering, the wheel and axle which rotate a virtual king-pin shaft as a core, a motor, and a reducer rotate, where the 4 component doubling ****** is located on a virtual king-pin shaft.
[0013] Invention of claim 5 is considered as the configuration which has arranged the reducer which slows down and transmits rotation of a motor between a motor and an axle, and has arranged 2 component doubling ****** of a motor and a reducer on a virtual king-pin shaft in the configuration of invention of claim 1.
[0014] According to the above-mentioned configuration, at the time of steering, the motor and reducer which rotate a virtual king-pin shaft as a core rotate, where the 2 component doubling ****** is located on a virtual king-pin shaft.
[0015] the drive gear which meshes with the output gear in which a reducer is constituted from an epicyclic gear device equipped with Sun Geer and a planetary gear in the configuration of claim 4 or invention of five, and invention of claim 6 carries out coaxial rotation with the output shaft of this epicyclic gear device -- the lower part location of said output gear -- the center-of-rotation shaft of a wheel -- the same axle -- it has considered as the configuration prepared pivotable.
[0016] According to the above-mentioned configuration, an epicyclic gear device and a motor are arranged above the drive gear of the center-of-rotation shaft of a wheel, and the same axle, and the space of a motor lower part becomes large.
[0017]
[Effect of the Invention] According to invention of claim 1, without causing the fuel consumption aggravation by increase of an engine load, since the center of gravity is arranged on the virtual king-pin shaft, the inertia weight of the circumference of a virtual king-pin shaft can mitigate, and the rotating part which rotates a virtual king-pin shaft as a core at the time of steering can make a control force small.
[0018] Since 3 component doubling ****** of a wheel, an axle, and a motor has been arranged on a virtual king-pin shaft according to invention of claim 2, the wheel, axle, and motor which rotate a virtual king-pin shaft as a core at the time of steering can be rotated where the 3 component doubling ****** is located on a virtual king-pin shaft, and the inertia weight of the circumference of a virtual king-pin shaft can be made to mitigate.
[0019] Since the center of gravity of a motor has been arranged on a virtual king-pin shaft according to invention of claim 3, the motor which rotates a virtual king-pin shaft as a core at the time of steering can be rotated where the center of gravity is located on a virtual king-pin shaft, and the inertia weight of the circumference of a virtual king-pin shaft can be made to mitigate.
[0020] Since according to invention of claim 4 the reducer which slows down and transmits rotation of a motor between a motor and an axle is arranged and 4 component doubling ****** of a wheel, an axle, a motor, and a reducer has been arranged on a virtual king-pin shaft The wheel and axle which rotate a virtual king-pin shaft as a core at the time of steering, a motor, and a reducer can be rotated where the 4 component doubling ****** is located on a virtual king-pin shaft, and the inertia weight of the circumference of a virtual king-pin shaft can be made to mitigate.
[0021] Since according to invention of claim 5 the reducer which slows down and transmits rotation of a motor between a motor and an axle is arranged and 2 component doubling ****** of a motor and a reducer has been arranged on a virtual king-pin shaft The motor and reducer which rotate a virtual king-pin shaft as a core at the time of steering can be rotated where the 2 component doubling ****** is located on a virtual king-pin shaft, and the inertia weight of the circumference of a virtual king-pin shaft can be mitigated.
[0022] According to invention of claim 6, a reducer is the epicyclic gear device equipped with Sun Geer and a planetary gear. the drive gear which meshes with the output gear which carries out coaxial rotation with the output shaft of this epicyclic gear device -- the lower part location of said output gear -- the center-of-rotation shaft of a wheel -- receiving -- the same axle, since it prepared pivotable An epicyclic gear device and a motor are arranged above the drive gear of the center-of-rotation shaft of a wheel, and the same axle, the lower part space of a motor becomes large, and the design degree of freedom of a motor becomes large.
[0023]
[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained based on a drawing.
[0024] Drawing 1 is basic structural drawing of the motor loading structure of a wheel in motor vehicle which shows one gestalt of implementation of this invention. While a brake 4 is formed in the axle 3 which supports the wheel 1 of car anterior part pivotable, it is equipped with the motor 5 which carries out the

rotation drive of the wheel 1 through the reducer 7 which slows down driving force and tells a wheel 1.
[0025] The shock absorber 11 is arranged between the motor 5 and the car body 9. It is the suspension virtual king-pin shaft (it is only hereafter called a virtual king-pin shaft) which is shown with the sign 17 which connects the upper mounting 13 used as the car-body side attachment section to the car body 9 of a shock absorber 11, and the ROWABORU joint 15 used as the axle side attachment section attached in the axle 3.
[0026] When the center of gravity of the rotating part at the time of steering is on the above-mentioned suspension virtual king-pin shaft 17, moment of inertia is zero, but if said center of gravity is offset from the virtual king-pin shaft 17, moment of inertia will occur at the time of steering, a steering control force will become large, and sense of incongruity will be given to a driver.
[0027] As the above-mentioned rotating part, it is a wheel 1, an axle 3, a motor 5, a reducer 7, and a shock absorber 11, and the center of gravity G of the components with which these five components were aligned is set up on the virtual king-pin shaft 17 here. The total increment in moment of inertia of the circumference of the virtual king-pin shaft 17 when steering a steering is prevented by this, a control force decreases, and a steering feeling becomes good. This does not need to make the pump capacity of power steering raise, therefore does not generate the fuel consumption aggravation by increase of an engine load, either.
[0028] In addition, with the gestalt of the above-mentioned implementation, although a wheel 1, an axle 3, a motor 5, a reducer 7, and all five components of a shock absorber 11 were taken into consideration as a rotating part, the total increment in moment of inertia of the circumference of the virtual king-pin shaft 17 is prevented, without making the pump capacity of power steering raise, even if it sets up the center of gravity of the entire component which combined any one or two or more components on the virtual king-pin shaft 17. Thus, a design becomes easy by lessening the number of components which takes a center-of-gravity location into consideration as a rotating part.
[0029] For example, the center of gravity of only a motor 5 may be set up on the virtual king-pin shaft 17, and the center of gravity of 3 component doubling ****** of a wheel 1, an axle 3, and a motor 5 may be set up on the virtual king-pin shaft 17, and the center of gravity of 2 component doubling ****** of a motor 5 and a reducer 7 may be further set up on the virtual king-pin shaft 17.
[0030] Drawing 2 shows the detail structure of drawing 1 . As a wheel 1, a roadwheel 21 is equipped with a tire 19 and the axle 3 consists of a brake disc 23, a hub 25, a spindle 27, and axle bearing 29. A brake disc 23 and a hub 25 are fixed to a roadwheel 21 with the bolt nut 31, and the spindle 27 is being fixed to the hub 25 from the nut 32.
[0031] While the shaft 35 to which Rota 33 was fixed is formed in the motor housing 39 pivotable through the motor bearing 37 of a pair, as for the motor 5, the inside of the motor housing 39 is equipped with the stator 41. Moreover, the rotational frequency sensor 43 which detects the rotational frequency of a motor 5 is formed in the exterior of the motor housing 39 of the left end section all over drawing of a shaft 35.
[0032] As the lower limit of a shock absorber 11 where upper limit is connected with the car body 9 is shown in drawing 4 which is the top view of drawing 3 which is the A-A sectional view of drawing 2 , and drawing 3 , the mounting bracket 45 prepared in the lower part of a shock absorber 11 is concluded by heavy-gage part 39a of the motor housing 39 with a bolt 47, and is being fixed to the motor housing 39.
[0033] In addition, in above-mentioned drawing 3 , the internal stator 41 etc. is omitted and has omitted the mounting bracket 45 and heavy-gage part 39a in drawing 3 R> 3 in drawing 2 .
[0034] A reducer 7 consists of epicyclic gear devices equipped with the sun gear 49 fixed to the shaft 35 of the part projected on right-hand side all over drawing of the motor housing 39, and two or more planetary gears 51 which mesh to a sun gear 49, and these are held in the reducer housing 53. Inner skin is equipped with the ring gear 55 with which two or more planetary gears 51 mesh, and the reducer housing 53 is being fixed to the motor housing 39 with the bolt which is not illustrated. The carrier 57 which connects both [two or more] planetary gear 51 is connected with the above mentioned spindle 27, and the rotational motion force from a reducer 7 is transmitted to an axle 3 and a wheel 1.
[0035] The above-mentioned motor housing 39 and the above-mentioned reducer housing 53 are constituting the reducer housing 53 with which reinforcement's is demanded from iron, while it constitutes from an another object mutually and the motor housing 39 with which heat dissipation nature's is demanded for this reason is constituted from aluminum material etc., and an optimum design becomes possible.
[0036] The ROWABORU joint 15 here is attached in the attachment section 59 projected in the lower part by the side of the reducer 7 of the motor housing 39 pivotable, and the other end of the lower link 61 as a suspension link by which the end is connected with the ROWABORU joint 15 is connected with the car-body 13 side pivotable.

[0037] The straight line which connects the upper mounting 13 and the ROWABORU joint 15 is the virtual king-pin shaft 17, and a tire 19 is steered by setting a revolving shaft as this virtual king-pin shaft 17.
[0038] Next, how to set the center of gravity G of a rotating part as the virtual king-pin shaft 17 is explained.

[0039] Since each part article 11 which constitutes a rotating part, for example, a shock absorber, is what is designed according to the weight and the military requirement of the car, if an optimum design is performed, the magnitude will be decided inevitably. A motor 5, a reducer 7, an axle 3, a wheel 1, etc. are the same.
[0040] By the way, in the design of a motor 5, relation like a degree type between output:P, motor diameter:phiD, and motor die-length (width of face):L is.
[0041] P**DXL (P), i.e., a motor output, is proportional to the product of motor diameter:phiD and motor die-length:L.
[0042] If this relation is used, even if it is the motor of the same output, a long motor or a motor short at a major diameter can be designed in a minor diameter. By the design approach of a motor, even if this is the motor of the same output, it means that the center-of-gravity location of a motor 5 is adjustable.
[0043] The example of modification of the center-of-gravity location by the motor configuration is shown in drawing 5 . According to this, when there is a center of gravity G of the rotating part of the circumference of the virtual king-pin shaft 17 inside a car (it is left-hand side in drawing 5) to the virtual king-pin shaft 17, motor 5a (center-of-gravity location Ga of a motor) of a short configuration, then a center of gravity Ga are changed into a car outside by the major diameter, and it is set as a near location with the virtual king-pin shaft 17. On the other hand, when the center of gravity G of the rotating part of the circumference of the virtual king-pin shaft 17 is located to the virtual king-pin shaft 17 on the outside (it is right-hand side in drawing 5) of a car, motor 5b (center-of-gravity location Gb of a motor) of a long configuration, then a center of gravity Ga are changed into the car inside in a minor diameter, and it is set as a near location with the virtual king-pin shaft 17.
[0044] In addition, according to the configuration of a motor 5, the strut which is the component part of a shock absorber 11 changes die length, and corresponds.
[0045] The car (continuous line) which carried the wheel in motor for the data of the frequency-response experimental result of a control force, and the car which does not carry the wheel in motor compare and show drawing 6 . A wheel in motor loading vehicle is the case (the center-of-gravity location of a rotating part is not in agreement to a virtual king-pin shaft) where the center of gravity of a rotating part offsets to a virtual king-pin shaft.
[0046] According to this, the control force is large to the car with which especially the wheel in motor loading vehicle does not carry the wheel in motor by nearly 1Hz, and this is worsening a feeling of steering. That is, if the center-of-gravity location of a rotating part is made in agreement to the virtual king-pin shaft 17, it means that the increment in a control force is avoided.
[0047] Drawing 7 shows the gestalt of other operations of this invention. The gestalt of this operation attaches in the spindle 27 used as the center-of-rotation shaft of a wheel 1 the drive gear 67 which meshes with the output gear 65 in the lower part location of the output gear 65, and constitutes the reducer 7 in it while it attaches the output gear 65 in the output shaft 63 of the epicyclic gear device in a reducer 7. Moreover, while making the reducer housing 53 support the opposite side pivotable by bearing 69 a connection-on carrier 57 of output shaft 63 side, a carrier 57 is arranged on both sides of a planetary gear 51, and the motor housing 39 is made to support the left-hand side carrier 57 pivotable through bearing 71.
[0048] The ROWABORU joint 15 of a lower link 61 is attached in the mounting bracket 73 prepared in the lower part of the reducer housing 53.
[0049] In the above-mentioned gestalt of operation of drawing 7 , since a motor 5 and an epicyclic gear device can be arranged to the gestalt of operation of drawing 2 R> 2 more nearly up than that of a car body, the large space S of a motor 5 and a lower link 61 can be taken, and, for this reason, the design degree of freedom (setting degree of freedom of a center of gravity G) of a motor 5 becomes large.
[0050] In drawing 7 , the lower link 61 shows the condition of being a continuous line and having bounded the condition with a normal shock absorber 11, with the two-dot chain line, and even if it is in a bound condition, it turns out that the path clearance between lower links 61 with a comparatively big motor 5 is obtained.
[0051] In addition, with the gestalt of each above-mentioned implementation, although the electric motor explained the structure of a motor 5, even if a hydraulic motor constitutes, the same effectiveness is acquired. Moreover, although the gestalt of each above-mentioned implementation explained the shock absorber 11 in the strut format, you may be other formats as long as it has a king-pin shaft (a virtual king-pin

shaft is included).

[Translation done.]

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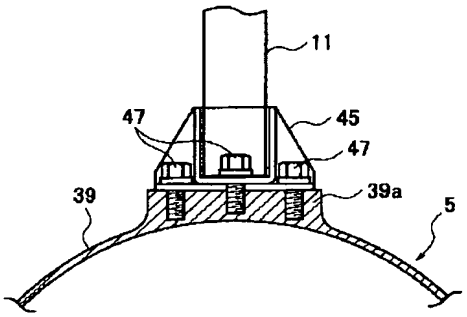
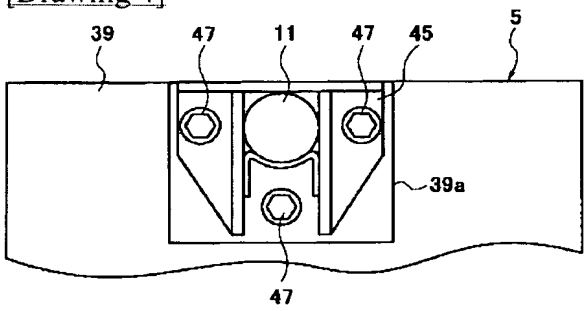
DRAWINGS

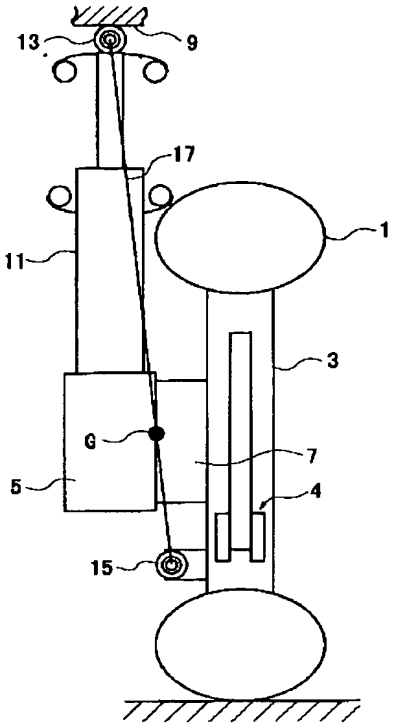
[Drawing 3]



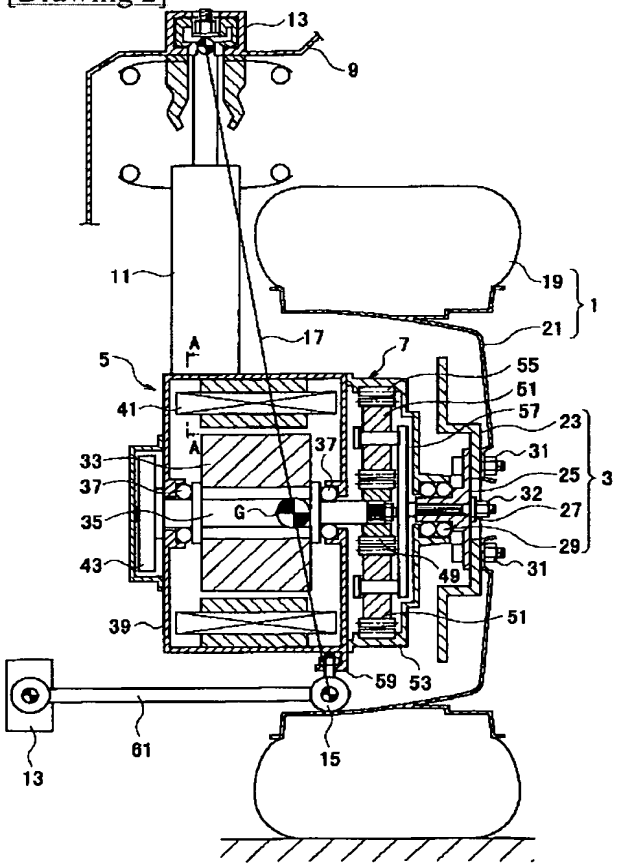
[Drawing 4]



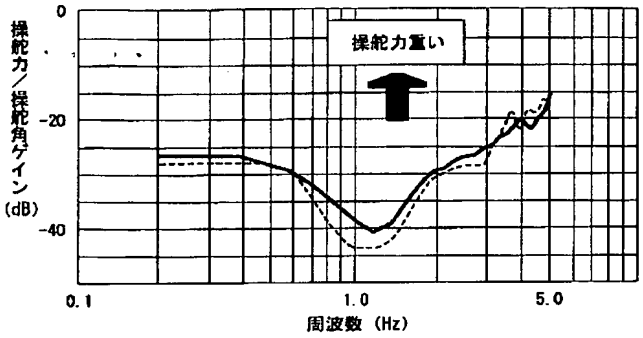
[Drawing 1]



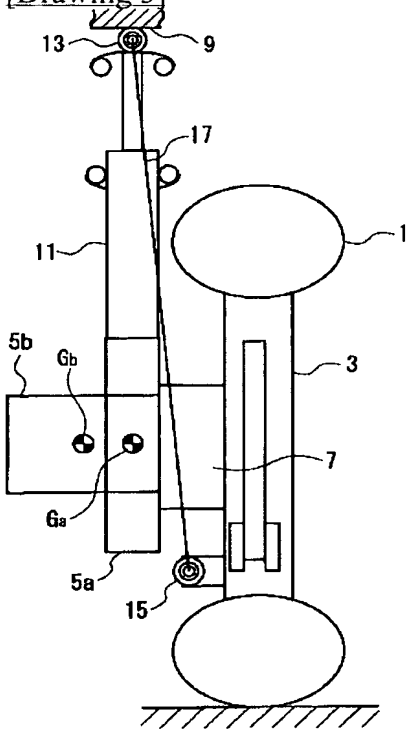
[Drawing 2]



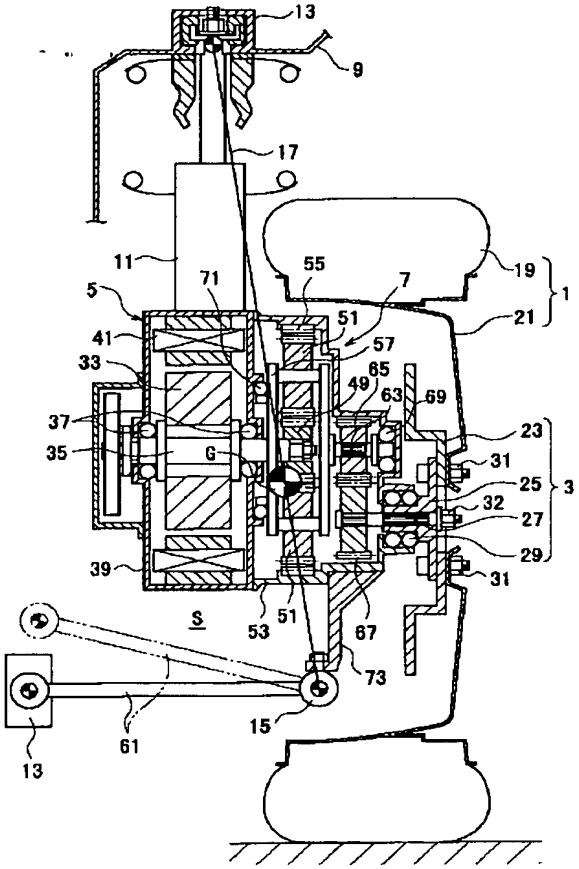
[Drawing 6]



[Drawing 5]



[Drawing 7]



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